Poster 130: Using Error Augmentation in Immersive VR for Bimanual Upper Limb Rehabilitation of Youth with Hemiplegic Motor Disorders

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Abstract: Immersive virtual reality (VR) is quickly becoming accurate enough to match veridical upper limb movements while still providing new types of visual feedback in the form of positioning augmentation during bimanual movements. By accentuating the positioning error of the limb from the movement goal, visual feedback in a meaningful and noticeable manner can be presented in real time. A bimanual error augmentation (EA) training paradigm for upper limb motor disorders was developed and tested with two participants with hemiplegic cerebral palsy (CP) in order to explore the effectiveness of visual feedback based on the difference between the forward position of the weaker and stronger sides in asymmetric motor dysfunctions. During a single-session experiment, participants performed two training sets – one with and one without EA – of bilateral symmetric forward reaching in a VR environment developed for the Oculus Rift HMD and Touch controller system. Quantitative kinematic datasets were collected using the Oculus system’s IR tracking. Results showed that both participants improved their lateral symmetry during the reaching task more with the application of visual EA in comparison to the same reaching task with no visual augmentation. Discussions on differences in the participants’ average improvement of symmetrical forward reaching and symmetry error profiles are presented.
Poster 100: Seated auto-balancing mobility devices: preliminary testing of potential hazards during use

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Abstract: Two-wheeled electric auto-balancing seated vehicles (EASV) are a new type of mobility device. Relying on Segway-style technology, they can access environments that limit the effectiveness of power wheelchairs (PWCs). The novel control method, lack of casters, small footprint, and high-powered motors open up new possibilities, but also introduce a whole new set of poorly understood hazards. This preliminary study investigated two situations that are potentially dangerous to a EASV user, which should help the community understand this new technology, prioritize future research, guide user training and inform product developers. The Nino®, an EASV collaboration between Nino Robotics® and Segway (Ninebot®) was device evaluated. Two use situations were studied. First, braking was characterized. It was found that at greater speeds a higher deceleration was achieved. In general, braking distances from varying speeds were much longer than those of conventional PWCs. Second, we characterized issues when entering parked or standby mode, i.e. when the electric kickstands were engaged, which stabilize the device when powered off and during transfers. Testing revealed the importance of being very aware of your surface and surroundings, because if the kickstands were lowered on uneven ground, slopes or while moving, dangerous situations arise, including uncontrolled spins, tipping and/or quick accelerations. Potential future research includes testing on slippery surfaces, inadvertently hitting an immoveable object, and device behaviour during user spasms. Performing activities of daily living in auto-balancing mode should also be studied. EASVs represent exciting new mobility possibilities. However, there are several hazardous scenarios that potentially need design improvements and user training to mitigate. With a technology so linked to the user’s wellbeing, appropriate steps must be taken to ensure device safety before the full range of new benefits can be realized.

Primary Subject Area: NEW: Emerging Technology
Secondary Subject Areas:
Poster 72: The effect of robot-assisted self-locomotion on the executive function of typically developing, non-crawling infants and its implications for infants with motor impairment

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Abstract: Most previous studies comparing the development of executive function in locomotor and non-locomotor children have been correlational, meaning that there is a relationship between locomotor experience and development of executive function, but that no clear cause and effect can be established. In this paper we present the results of an experimental study on the effect of robot-assisted, self-locomotion on executive function (specifically, object permanence using the A-not-B task) in pre-crawling infants. The hypothesis was that there would be a causal effect between infants with self-locomotor experience and superior performance on the A-not-B object permanence task. The results of this study do indeed demonstrate a causal relationship between the two. Pre-crawling, typically developing infants provided with the ability to self-locomote showed better performance on the A-not-B task than did infants in the non-mobile control group. This finding, in addition to its contribution to developmental science, also has implications for the cognitive development of infants with motor impairment, supporting the growing belief that infants with motor impairment should be provided with mobility devices at as early an age as is possible.

Primary Subject Area: SM: Seating and Mobility including Complex Rehabilitation Technology (CRT)
Secondary Subject Areas: COG: Cognitive and Sensory Impairments
Poster 77: The interaction of wheelbase and push handle forces for novice wheelchair pushers

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Abstract: In low and middle-income countries (LMIC) where power wheelchairs are often not available, the ease of pushing a wheelchair has a greater impact on mobility. A simple two-dimensional model of wheelchair rolling resistance was constructed. Data was collected using the Aspects of Wheelchair Mobility Test model which includes distance traveled in four minutes, a visual analogue scale question and qualitative comment. The goal was to shed light on wheelchair structures and human behaviors that impact the ease of pushing a wheelchair. As our model predicted, downward pressure on push handles and a longer wheelbase resulted in decreased rolling resistance. This was evident in significantly longer distance traveled and higher visual analogue scale responses for perceived ease of travel. This strongly suggests that wheelchair designs for LMIC should take into consideration push-handle and wheelbase characteristics to benefit the ease of pushing.

Primary Subject Area: SM: Seating and Mobility including Complex Rehabilitation Technology (CRT) Secondary Subject Areas: OUT: Service Delivery, Outcomes, & Measurement